

PCTWORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁶ : F04B 17/00, 35/02, 43/10, E21B 15/02	A3	(11) International Publication Number: WO 99/50524 (43) International Publication Date: 7 October 1999 (07.10.99)
(21) International Application Number: PCT/US99/06111 (22) International Filing Date: 26 March 1999 (26.03.99) (30) Priority Data: 60/079,641 27 March 1998 (27.03.98) US 09/276,406 25 March 1999 (25.03.99) US (71) Applicant: HYDRIL COMPANY [US/US]; 3300 North Sam Houston Parkway East, Houston, TX 77032 (US). (72) Inventors: MOTT, Keith, C. (deceased). PELATA, Kenneth, L.; 1335 Old FM 306, New Braunfels, TX 78130 (US). COLVIN, Kenneth, W.; 4027 Wintergreen Drive, Humble, TX 77396 (US). (74) Agents: OSHA, Jonathan, P. et al.; Rosenthal & Osha L.L.P., Suite 4550, 700 Louisiana, Houston, TX 77002 (US).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> (88) Date of publication of the international search report: 2 December 1999 (02.12.99)
(54) Title: SUBSEA MUD PUMP (57) Abstract <p>A positive-displacement pump (102) includes multiple pumping elements (355, 356). Each pumping element having a pressure vessel (356) with a first (372) and a second (370) chamber and a separating member (362) disposed between the first (372) and second (370) chambers. The first (372) chambers and the second (370) chambers are hydraulically connected to receive and discharge fluid, wherein the separating members (362) move within the pressure vessels (356) in response to pressure differential between the first (372) and second (370) chambers. A valve assembly (378) having suction (380) and discharge (382) valves communicates with the first (372) chambers. The suction (380) and discharge (382) valves are operable to permit fluid to alternately flow into and out of the first (372) chambers. A hydraulic drive (420) alternately supplies hydraulic fluid to and withdraws hydraulic fluid from the second (370) chambers such that the fluid discharged from the first (372) chambers is free of pulsation.</p>		

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LI	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/06111

A. CLASSIFICATION OF SUBJECT MATTER IPC(6) : F04B 17/00, 35/02, 43/10; E21B 15/02. US CL : 417/395, 390, 521; 137/596.17; 251/129.07, 324, 282. According to International Patent Classification (IPC) or to both national classification and IPC														
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) U.S. : 417/390, 392, 395, 401, 505, 521, 533; 137/596.17; 251/129.07, 324, 282. Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) Please See Extra Sheet.														
C. DOCUMENTS CONSIDERED TO BE RELEVANT														
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.												
X	US 2,703,055 A (Veth et al.) 01 March 1955, particularly see col. 1, lines 34-42 and col. 4, lines 58-70; generally see all.	1-2, 4-8, 11-13												
X	US 4,755,111 A (Cocchi et al.) 05 July 1988, particularly see col. 4, lines 20-21; generally see all.	1-2, 4, 8, 11												
X	US 4,705,462 A (Balembois) 10 November 1987, see Fig. 1 and col. 2, lines 3-11.	1-2, 12												
X	US 5,924,448 A (West) 20 July 1999, see claims, abstract and related US application data.	1-2, 4, 11												
X	US 4,832,005 A (Takamiya et al.) 23 May 1989, see col. 4, lines 34-45 and col. 4, lines 65-68.	1-2, 4, 11-13												
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.														
<table border="0"> <tr> <td>* Special categories of cited documents:</td> <td>*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</td> </tr> <tr> <td>*A* document defining the general state of the art which is not considered to be of particular relevance</td> <td>*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</td> </tr> <tr> <td>*E* earlier document published on or after the international filing date</td> <td>*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</td> </tr> <tr> <td>*L* document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</td> <td>*G* document member of the same patent family</td> </tr> <tr> <td>*O* document referring to an oral disclosure, use, exhibition or other means</td> <td></td> </tr> <tr> <td>*P* document published prior to the international filing date but later than the priority date claimed</td> <td></td> </tr> </table>			* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	*A* document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	*E* earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	*L* document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family	*O* document referring to an oral disclosure, use, exhibition or other means		*P* document published prior to the international filing date but later than the priority date claimed	
* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention													
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone													
E earlier document published on or after the international filing date	*Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art													
L document which may throw doubt on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*G* document member of the same patent family													
O document referring to an oral disclosure, use, exhibition or other means														
P document published prior to the international filing date but later than the priority date claimed														
Date of the actual completion of the international search 14 SEPTEMBER 1999		Date of mailing of the international search report 19 OCT 1999												
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230		Authorized officer ROBERT Z. EVORA <i>Robert Z. Evora</i> Telephone No. (703) 308-0863												

INTERNATIONAL SEARCH REPORT

 International application No.
 PCT/US99/06111

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,516,429 A (Snodgrass et al.) 14 May 1996, see col. 4, lines 38-46.	1-3, 11-13
X	US 4,523,901 A (Schippers et al.) 18 June 1985, see Figures.	1-2, 4, 8, 11
X	US 4,611,578 A (Heimes) 16 September 1986, see Figures and col. 8, lines 20-44.	1-2
X	US 2,419,993 A (Green et al.) 06 May 1947, see generally all.	1-2
Y	US 5,622,482 A (Lee) 22 April 1997, see abstract.	3
Y	US 5,558,506 A (Simmons et al.) 24 September 1996, see abstract.	3
Y	US 2,723,681 A (MacGlashan, Jr. et al.) 15 November 1955, see Figures and description generally.	8-9
Y	US 2,854,998 A (MacGlashan, Jr., et al.) 07 October 1958, see Figures and col. 2, lines 32-38.	8-10
Y	US 5,443,241 A (Odaira et al.) 22 August 1995, see Figure 1.	8-9
Y	US 5,263,514 A (Reeves) 23 November 1993, see Figure 1.	8-9
Y	US 5,297,777 A (Yie) 29 March 1994, see Figure 4d and col. 8, lines 49-68.	8-10
Y	US 4,632,358 A (Orth et al.) 30 December 1986, see Figures 1-2 and col. 5, lines 40-46.	8-10
Y	US 5,149,055 A (Huber et al.) 22 September 1992, see Figure 1.	8-9
Y	US 3,047,018 A (Lucien) 31 July 1962, see Figures.	10
X	US 5,480,292 A (Chevallier) 02 January 1996, see generally all.	1-2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/06111

B. FIELDS SEARCHED

Electronic data bases consulted (Name of data base and where practicable terms used):

APS, EAST.

search terms: pump, diaphragm, piston, hydraulic, subsea, mud, fluid, liquid, pulse, pulsation, reduce, valve, booster, positive, displacement, control, reverse flow, actuator, pressure, plunger, ribs, position, locator, pressure sensor.